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Morscrangon acutus n. gen. n. sp.
(Crustacea, Decapoda, Caridea)
from the Fur Formation (Early Eocene)
of the Islands of Mors and Fur (Denmark)

Abstract - An assemblage of macruran decapod crustaceans discovered in the Islands of Mors and Fur (Denmark) was collected from the Fur Formation (early Eocene) and represents the basis for erecting a new genus. The studied specimens are ascribed to the new genus *Morscrangon* with *M. acutus* n. sp. (infraorder Caridea Dana, 1852, family Crangonidae Haworth, 1825). The family Crangonidae Haworth, 1825, was reported for the first time in the fossil record by Garassino & Teruzzi (2001) who described *Crangon miocenicus* from the lower Miocene of N Caucasus (Russia). *Morscrangon* n. gen. is the oldest report of this family in the fossil record, increasing its stratigraphic range from the early Eocene to Recent.

Key words: Crustacea, Decapoda, early Eocene, Denmark.

Riassunto - *Morscrangon acutus* n. gen. n. sp. (Crustacea: Decapoda: Caridea) della Formazione di Fur (Eocene inferiore) delle Isole di Mors e Fur (Danimarca).

Un piccolo campione di crostacei decapodi macruri, rinvenuto nelle Isole di Mors e Fur (Danimarca), è stato scoperto nella Formazione di Fur (Eocene inferiore), rappresentando la base per la creazione di un nuovo genere. Gli esemplari studiati sono stati ascritti al nuovo genere *Morscrangon* con *M. acutus* n. sp. (infraordine Caridea Dana, 1852, famiglia Crangonidae Haworth, 1825). La famiglia Crangonidae Haworth, 1825, è stata segnalata per la prima volta nel record fossile da Garassino & Teruzzi (2001) nel Miocene inferiore del Caucaso (Russia). *Morscrangon* n. gen. rappresenta la più antica segnalazione di questa famiglia nel record fossile, ampliandone la distribuzione stratigrafica dall'Eocene inferiore all'attuale.

Parole chiave: Crustacea, Decapoda, Eocene inferiore, Danimarca.

Introduction

The fossil record of the Fur Formation (early Eocene) comprises a rich fauna of especially well-preserved vertebrates and insects that has attracted numerous palaeon-

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tologists through the last hundred years and has resulted in a relatively rich literature.

The decapod crustacean fauna of the Fur Formation is exceedingly rare and has received little attention. The first record was an unidentified shrimp briefly mentioned and figured by Bonde (1987) and Jakobsen (1991). Subsequently a small assemblage of similar shrimps, have been discovered (during a routine curatorial procedure) in the collection of the Geological Museum. These specimens now form the basis for the present study.

Subsequently Bonde (2003), in his unpublished paper, briefly outlined the presence of crustaceans in the Danish Eocene deposits and notice was drawn to undescribed species of branchiopods and cirripeds (presumably related to *Catophragmus*) attached to driftwood from Fur Formation. A rare occurrence of two brachyuran decapods are under description by Collins, Schulz, and Jakobsen (work in progress).

The only scientific contribution to the decapod fauna, however, was recently given by Garassino & Harper (2004), who described two new species of macruran decapod crustaceans, recovered from the basal part of the Ølst Formation, the Stolle Klint Clay, on the Island of Fur.

The approach of the present study is to describe the oldest occurrence of the family Crangonidae Haworth, 1825.

Geographic and geologic setting

The Fur Formation (early Eocene) is composed of an approximately 60 m thick unit of highly porous diatomite (earlier named mo-clay) interbedded with 179 isochronous layers of volcanic ash (Pedersen & Buchardt, 1996), which have facilitated the establishment of a detailed local stratigraphy. The ash-layers, numbered according to their relative age from -39 (the oldest layer) to 140 (the youngest layer), are found in several other Danish formations and all over the North Sea Basin (Heilmann-Clausen, 1995). The ash-layers of the Fur Formation have been associated with volcanic activity during the early Paleogene period (60-54 m. y.) when Greenland and Europe drifted apart.

Calcareous concretions, occurring at certain levels in the formation, are the principal source of usually well-preserved fossils.

The stratigraphic position of the Fur Formation has long been a subject of controversy. Through the last century, various geologists have alternatively referred the formation to the late Paleocene and the early Eocene. Based on biostratigraphic correlation (dinoflagellates) the Paleocene/Eocene boundary was positioned within the Fur Formation (Heilmann-Clausen *et al.*, 1985; Thomsen & Danielsen, 1995), but with no precise definition of the Paleocene/Eocene boundary. In recent research, however, sediments from Fur Formation and Stolle Klint Clay are now referred to early Eocene (Willumsen, 2004).

Sediments belonging to the Fur Formation are exposed in several localities in north-western part of Denmark, in particular of the Islands of Fur and Mors (from where the studied specimens are found) (Fig. 1).

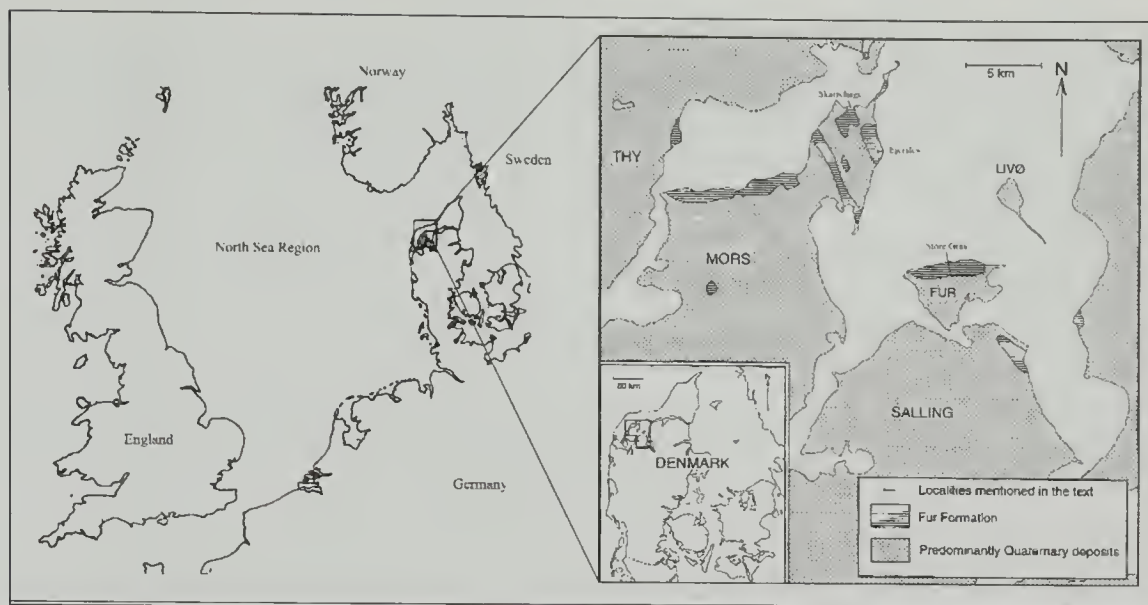


Fig. 1 - Sketch map showing localities mentioned in the text. (Ubicazione delle località menzionate nel testo).

Palaeoenvironment

During the latest Paleocene, the sediments of the Fur Formation were deposited on the bottom of an epicontinental sea covering Denmark in early Paleogene time. Based on the composition of the fish fauna, Bonde (1974) suggested that the formation was deposited at some distance from the coast at depths of 50 – 500 m.

The uniform lamination of the diatomite indicates that the sediment was deposited without being disturbed by wave action and also suggests that bottom-dwelling, burrowing marine animals were almost absent due to anoxic or dysoxic conditions possibly related to an upwelling system (Bonde, 1974) or stagnant seabed (Knox & Harland, 1979), within an enclosed basin system.

The rare occurrence of crustaceans in such an unfavourable environment on the seafloor could possibly be explained by a semipelagic behaviour in floating seaweed.

Materials

The studied specimens are almost exclusively preserved in cementstone as flattened specimens in various positions. Dorsal, ventral, and lateral positions are observed, giving the optimal possibilities for the study of all morphological characters within the species. Two specimens found at Store Grav, Fur (MGUH 27339, GM 2004.1777) are preserved in diatomite but no exact level is indicated. Nine specimens from Skarrehage, Mors (MGUH 27338, MGUH 27340, GM 2004.1769, GM 2004.1771-1776) are preserved in calcareous concretions (cementstone) extracted from just below ash layer -17. Two specimens (no number indicated) and the holotype (MGUH 27337) were found at Ejerslev Molegrav, Mors and are preserved in cementstone.

All specimens belong to the same species and are ascribed to the new genus *Morscrangon* with *M. acutus* n. gen. n. sp. (infraorder Caridea Dana, 1852, family Crangonidae Haworth, 1825) designated the type species. Apart from the unnumbered specimen (collection Moler museet, Mors), all the specimens are housed in the type-collection at Geological Museum, Copenhagen.

Acronym. GM & MGUH: Geological Museum, Copenhagen.

Systematic Palaeontology

Infraorder Caridea Dana, 1852
Family Crangonidae Haworth, 1865
Genus *Morscrangon* nov.

Diagnosis: subrectangular carapace compressed dorso-laterally; edentate short rostrum; four strong spines located in the posterior part of the dorsal margin of carapace; one short carina located in the upper part of the branchial region of carapace; one elongate carina located in the median part of carapace; very elongate antennal spine; very elongate posterior lateral spine; pereopod I subchelate; pereopod II-V without chelae; dorsal surface of the tergite of abdominal somites III-VI with sharp spines protruded backward; exopodite without diaeresis.

Type species: *Morscrangon acutus* n. sp.

Etymology: the trivial name alludes to Mors Island where the studied specimens were discovered.

Description: same as for type species.

Morscrangon acutus n. sp.
Figs. 2-6

Diagnosis: same as for genus.

Etymology: the trivial name takes origin from the latin word *acutus*, *a, um* = sharp.

Holotype: MGUH 27337 (specimen a).

Paratypes: MGUH 27338, MGUH 27339 a-b, MGUH 27340.

Type locality: Ejerslev Molergrav (Mors Island, Denmark).

Geological age: early Eocene.

Occurrence and measurements: we ascribe to this new species 14 specimens in lateral, dorsal, and ventral view. The different view of the studied specimens allowed all morphological characters of this new species to be described.

MGUH 27337; MGUH 27338; MGUH 27339; MGUH 27340; GM 2004.1769; GM 2004.1771; GM 2004.1772; GM 2004.1773; GM 2004.1774; GM 2004.1775; GM 2004.1776; GM 2004.1777; two specimens without catalogue number from the collection Moler museet, Mors Island.

The specimens range in length between 3.5 and 5.5 cm.

Description. Small-sized caridean with smooth exoskeleton.

Carapace. Subrectangular carapace compressed dorso-laterally. Edentate short rostrum with pointed distal extremity. Four strong spines in the posterior part of dorsal margin directed forward. Posterior margin with a weak marginal carina. One

short carina, located in the upper part of branchial region, with two small spines at the extremities. One denticulate carina, located in the median part, extends parallel the total length of carapace. One very elongate spine extends from the posterior part of the median carina outward. Elongate and strong antennal spine. Narrow ocular incision. Weak antennal and pterigostomial angles.

Abdomen. Subrectangular somites I-VI of equal length with pointed ventral margins. Subrounded pleura of somite II overlapping those of somite I and III. Dorsal surface of the tergite of abdominal somites III-VI with sharp spines directed backward. Pleura of somite VI with one strong and sharp spine directed down and backward. Triangular telson with pointed distal extremity. Subrectangular propodite. Endopodite and exopodite as long as telson. Exopodite without diaeresis.

Cephalic appendages. Large eye with a short eyestalk. Very elongate, spineless 3rd maxilliped. Antennulae and antennae not preserved.

Thoracic appendages. Pereopod I subchelate with an elongate, strong propodus. Pereopods II-V with elongate, thin articles and terminal dactylus.

Abdominal appendages. Pleopods not preserved.

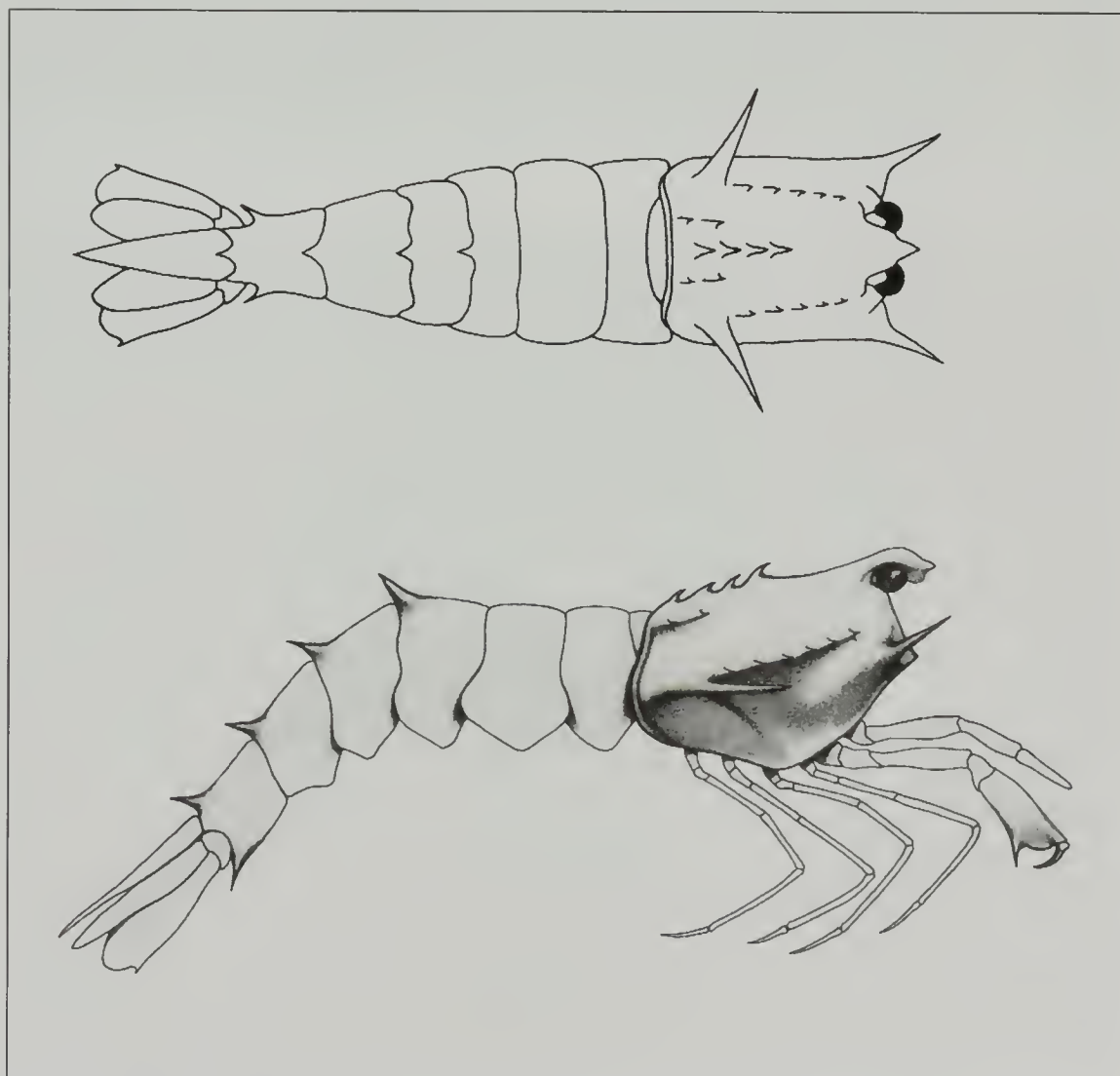


Fig. 2 - *Morscrangon acutus* n. gen. n. sp., reconstruction (ricostruzione).



Fig. 3 - *Morscrangon acutus* n. gen. n. sp., holotype (olotipo), n. cat. MGUH 27337 (x 1.2).



Fig. 4 - *Morscrangon acutus* n. gen. n. sp., paratype (paratipo), n. cat. MGUH 27338 (x 2).



Fig. 5 - *Morscrangon acutus* n. gen. n. sp., paratype (paratipo), n. cat. MGUH 27339 (x 2.5).



Fig. 6 - *Morscrangon acutus* n. gen. n. sp., paratype (paratipo), n. cat. MGUH 27340 (x 2.5).

Discussion. Carideans are very rare in the fossil record and their morphological characters are not easily recognized because of their frequent poor state of preservation.

The oldest genera known to date, *Acanthinopus* Pinna, 1974, and *Leiothorax* Pinna, 1974, were discovered in the Zorzino Limestone (Norian, Upper Triassic) of Bergamo Pre-alps (Cene, Seriana Valley, Bergamo – N Italy) (Pinna, 1974). Another form, *Pinnacaris* Garassino & Teruzzi, 1993, was described in the Argilliti di Riva di Solto (Sevatian, upper Norian-lower Rhaetian, Upper Triassic) of Ponte Giurino (Imagna Valley, Bergamo – N Italy) (Garassino & Teruzzi, 1993).

Glaessner (1969) ascribed to the carideans the Jurassic genus *Udorella* Oppel, 1862 (family Udorellidae Van Straelen, 1925) and he also noted three additional Jurassic genera as *incertae sedis* to the carideans: *Blaculla* Münster, 1839, *Hefriga* Münster, 1839, and *Udora* Münster, 1839. Garassino & Schweigert (in press) confirmed the ascription of these three genera to the carideans and described the new genus *Ctenodusa* (indeterminate family).

Recently, Schweigert (2002) described *Schmelingia* (family Palaemonidae Rafinesque, 1815) with *S. wulfi* Schweigert, 2002, from the Tithonian (Upper Jurassic) of Germany and Schweigert & Garassino (2004) described *Pleopteryx* and *Buergerocaris* (indeterminate families) with *P. kuempeli* Schweigert & Garassino, 2004, and *B. psittacoides* Schweigert & Garassino, 2004 respectively from the Tithonian (Upper Jurassic) of Germany.

Presently, we recognize nine genera of Cretaceous carideans. First, v. der Marck (1863) described *Gampsurus* (indeterminate family) with *G. dubius* v. der Marck, 1863, from the Senonian (Upper Cretaceous) of Germany. Second, Roger (1946) described *Notostomus cretaceus* Roger, 1946, and *Oplophorus syriacus* Roger, 1946 (family Oplophoridae Dana, 1852), from the Santonian (Upper Cretaceous) of Sahel Alma (Lebanon). *Notostomus cretaceus* was the subject of a review by Garassino (1994) who assigned Roger's species to *Odontochelion* Garassino, 1994 (family Oplophoridae Dana, 1852). Third, Martins-Neto & Mezzalana (1991b) found a few specimens of carideans in the Crato Member of the Santana Formation (Lower Cretaceous) of Brazil. The perfect state of preservation of these specimens allowed description of *Beurlenia* (family Palaemonidae Rafinesque, 1815) with *B. araripensis* Martins-Neto & Mezzalana, 1991b, as the type species. Fourth, Rabadà (1993) described *Delclosia* (family Atyidae De Haan, 1849) with *D. martinelli* Rabadà, 1993, from the lower Barremian (Lower Cretaceous) of Las Hoyas (Cuenca – Spain). This genus was the subject of a review by Garassino (1997). Fifth and sixth, Bravi & Garassino (1998 a, b) described *Parvocaris* (indeterminate family) with *P. sanunitica* Bravi & Garassino, 1998b, from the lower Albian (Lower Cretaceous) of Pietraroia (Benevento – S Italy) and *Alburnia* (family Palaemonidae Rafinesque, 1815) with *A. petinensis* Bravi & Garassino, 1998a, from the middle Albian (Lower Cretaceous) of Petina (Salerno – S Italy). Seventh, Garassino (1998) described *Tonellocaris* (family Oplophoridae Dana, 1852) with *T. brevirostrata* Garassino, 1998, from the Lower Cretaceous of the valley of Cornappo River (Udine – NE Italy). Eighth, Bravi *et al.* (1999) described *Palaemon* Weber, 1795

(family Palaemonidae Rafinesque, 1815) with *P. vesolensis* Bravi *et al.*, 1999, from the Campanian-Maastrichtian (Upper Cretaceous) of Vesole Mount (Salerno – S Italy). *Palaemon antonellae* Garassino & Bravi, 2003, from the Aptian (Lower Cretaceous) of the Platydolomite of Profeti (Caserta – S Italy) belongs to the same genus (Garassino & Bravi, 2003). Finally, Garassino *et al.* (2002) described *Yongjicaris* (family Palaemonidae Rafinesque, 1815) with *Y. zhejiangensis* Garassino *et al.*, 2002, from the Barremian (Lower Cretaceous) of Zhejiang Province (China). In addition to these named taxa, Garassino & Ferrari (1992) reported the presence of a caridean in the Senonian (Upper Cretaceous) of Trebiciano (Trieste – NE Italy) without ascribing it to a known family, genus, or species. Garassino & Teruzzi (1995) reported the probable presence of a new caridean from the upper Hauterivian-lower Barremian (Lower Cretaceous) of Vernasso (Udine – NE Italy).

Only seven genera of carideans are presently known from Cenozoic deposits. First, A. Milne Edwards (1837) described *Caridina* (family Atyidae, 1849) with *C. nitida* A. Milne Edwards, 1837, from the Oligocene of France. Second, there are four species referred to *Bechleja* Houša, 1956 (family Palaemonidae Rafinesque, 1815), a typical form of freshwater deposits: *B. rostrata* Feldmann *et al.*, 1981, from the Eocene of the Green River Formation (Wyoming, United States); *B. inopinata* Houša, 1956, from the Oligocene of the Czech Republic; *B. bahiaensis* (Beurlen, 1950) and *B. robusta* Martins-Neto & Mezzalira, 1991, from the Oligocene of Brazil (Beurlen, 1950; Houša, 1956; Feldmann *et al.*, 1981; Martins-Neto & Mezzalira, 1991a; Martins-Neto, 1998). Third, Martins-Neto & Mezzalira (1991a) ascribed to *Propalaemon* Woodward, 1903 (family Palaemonidae Rafinesque, 1815) the new species *P. longispinata* and they described *Pseudocaridinella* (family Palaemonidae Rafinesque, 1815) with *P. roxoi* (Beurlen, 1950), both species from the Oligocene of Brazil. Fourth, three genera are known from the Miocene deposits of N Caucasus (Russia): *Palaemon* Weber, 1795 (family Palaemonidae Rafinesque, 1815) with *P. mortuus* Smirnov, 1929, *Pasiphea* Savigny, 1816 (family Pasiphaeidae Dana, 1852) with *P. mortua* Smirnov, 1929, and *Crangon* Fabricius, 1798 (family Crangonidae Haworth, 1825) with *C. miocenicus* (Garassino & Teruzzi, 1996) (Smirnov, 1929; Garassino & Teruzzi, 2001).

Morscrangon acutus n. gen. n. sp., ascribed to the family Crangonidae Haworth, 1825, with its typical morphological character, the subchelate pereopod I, represents, according to the above-mentioned check list, the oldest genus of this family.

The family Crangonidae Haworth, 1825, is represented by twenty extant genera, widespread in all seas of the world (Holthuis, 1993). *Morscrangon* n. gen. bears some morphological characters, such as the strong and elongate antennal spine and the dorsal surface of the tergites of somites III-VI, similar to the living genera, *Paracrangon* Dana, 1852, and *Sclerocrangon* G. O. Sars, 1883 (Fig. 7). These genera are widespread respectively in the North Pacific, southern Australian, and Subantarctic waters; and in European Arctic waters.



Fig. 7 - *Paracrangon echinata* Dana, 1852 (location: Roxton Passage, Nanaimo; depth: 28-47 m; collection: Zoological Museum, Copenhagen).

Fig. 7 - *Paracrangon echinata* Dana, 1852 (località: Roxton Passage, Nanaimo; profondità: 28-47 m; collezione: Museo Zoologico, Copenhagen).

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References

- Beurlen K., 1950 – Alguns Restos de Crustáceos Decápodes d'água doce fósseis no Brasil. *Anais da Academia Brasileira de Ciências*, Rio de Janeiro, 22: 453-459.
- Bøggild O. B., 1918 – Den vulkanske aske i Mølnet (The volcanic ashlayer in the Mo-clay). *Danmarks geologiske Undersøgelse*, Ser. 2, 33: 1-84.
- Bonde N., 1974 – Palaeoenvironment as indicated by the “mo-clay formation” (Lowermost Eocene of Denmark). *Tertiary Times*, 2: 29-36.
- Bonde N., 1987 – Møln og fossiler – især fisk (Mo-clay and fossils – in particular bony fishes). *Skamol* (75 years anniversary volume).
- Bonde N., 2003 – Usædvanlige krebsdyr fra Danmarks Eocæn (Extraordinary crustaceans from the Eocene of Denmark). *Palaeontologisk Klub, Temamøde om Arthropoder, fossile og recente*.

- Bravi S. & Garassino A., 1998a – “Plattenkalk” of the Lower Cretaceous (Albian) of Petina, in the Alburni Mounts (Campania, S. Italy), and its decapod crustacean assemblage. *Atti Società italiana Scienze naturali Museo civico Storia naturale Milano*, Milano, 138 (1-2): 89-118.
- Bravi S. & Garassino A., 1998b – New biostratigraphic and palaeoecologic observations on the “Plattenkalk” of the Lower Cretaceous (Albian) of Pietraroia (Benevento, S Italy), and its decapod crustacean assemblage. *Atti Società italiana Scienze naturali Museo civico Storia naturale Milano*, Milano, 138 (1-2): 119-171.
- Bravi S., Coppa M. G., Garassino A. & Patricelli R., 1999 – *Palaemon vesolensis* n. sp. (Crustacea, Decapoda) from the Plattenkalk of Vesole Mount (Salerno, S Italy). *Atti Società italiana Scienze naturali Museo civico Storia naturale Milano*, Milano, 140 (2): 141-169.
- Feldmann R. M., Grande L., Birkeimer C. P., Hannibal J. T. & McCoy D. L., 1981 – Decapod fauna of the Green River Formation (Eocene) of Wyoming. *Journal of Paleontology*, Lawrence, 55 (4): 788-799.
- Garassino A., 1994 – The macruran decapod crustaceans of the Upper Cretaceous of Lebanon. *Paleontologia Lombarda*, Milano, Nuova Serie, III: 3-27.
- Garassino A., 1997 – The macruran decapod crustaceans of the Lower Cretaceous (Lower Barremian) of Las Hoyas (Cuenca, Spain). *Atti Società italiana Scienze naturali Museo civico Storia naturale Milano*, Milano, 137 (1-2): 101-126.
- Garassino A., 1998 – Nuovo studio sui crostacei decapodi del Cretacico inferiore (Barremiano-Aptiano) della Valle del Torrente Cornappo (Udine, NE Italia). *Gortania – Atti Museo Friulano Storia Naturale*, Udine, 20: 59-73.
- Garassino A. & Bravi S., 2003 – *Palaemon antonellae* n. sp. (Crustacea, Decapoda, Caridea) from the the Lower Cretaceous “Platydolomite” of Profeti (Caserta, S Italy). *Journal of Paleontology*, Lawrence, 77 (3): 589-592.
- Garassino A. & Ferrari R., 1992 – I crostacei fossili di Trebiciano sul Carso triestino. *Paleocronache*, Milano, 2 (1992): 40-44.
- Garassino A. & Harper D., 2004 – *Penaeus hamleti* n. sp. and *Penaeus furens* n. sp. (Crustacea: Decapoda: Penaeidae) from the Stolle Klint Clay (Paleocene) of Fur Island (Denmark). *Atti Società italiana Scienze naturali Museo civico Storia naturale Milano*, Milano, 145 (2): 329-336.
- Garassino A. & Teruzzi G., 1993 – A new decapod crustacean assemblage from the Upper Triassic of Lombardy (N Italy). *Paleontologia Lombarda*, Milano, Nuova Serie, I: 3-27.
- Garassino A. & Teruzzi G., 1995 – I crostacei decapodi macruri del Cretacico inferiore di Vernasso (Udine – NE Italia). *Gortania – Atti Museo Friulano Storia Naturale*, Udine, 16: 77-88.
- Garassino A. & Teruzzi G., 2001 – *Crangon miocenicus* (Garassino & Teruzzi, 1996) from the lower Miocene of N Caucasus (Russia) (Crustacea, Decapoda). *Atti Società italiana Scienze naturali Museo civico Storia naturale Milano*, Milano, 142 (1): 147-155.
- Garassino A. & Schweigert G., in press – The Upper Jurassic Solnhofen decapod crustacean fauna: review of the types from the old descriptions. *Memorie Società italiana Scienze naturali Museo civico Storia naturale Milano*, Milano.

- Garassino A., Yanbin S., Schram F. R. & Taylor R. S., 2002 – *Yongjicaris zhejiangensis* n. gen. n. sp. (Crustacea, Decapoda, Caridea) from the Lower Cretaceous of Zhejiang Province, China. *Bulletin Mizunami Fossil Museum*, Mizunami, 29: 73-80.
- Glaessner M., 1969 – Decapoda, 400-566. In: Treatise on Invertebrate Paleontology, Part R, Arthropoda 4. R. C. Moore (ed.), *Geological Society of America and University of Kansas Press*, Lawrence.
- Heilmann-Clausen C., 1995 – Palaeogene aflejring over Danskekalken (Paleogene deposits above the Danian limestone). In: Danmarks geologi fra Kridt til i dag. Nielsen O. B. (ed.), *Aarhus Geokompender*, 1: 71-114.
- Heilmann-Clausen C., Nielsen O. B. & Gersner F., 1985 – Lithostratigraphy and depositional environments of the Upper Paleocene and Eocene of Denmark. *Bulletin of the Geological Society of Denmark*, Copenhagen, 33: 287-323.
- Holthuis L. B., 1993 – The recent genera of the caridean and stenopodidean shrimps (Crustacea, Decapoda): with an appendix on the older Amphionidacea. *C. H. J. M. Fransen & C. van Achterberg*, Leiden.
- Houša V., 1956 – *Bechleja inopinata* n. g., n. sp. ein neuer Krebs aus dem böhmischen Tertiär (Decapoda, Palaemonidae). *Ustřed Ustavu Geologické*, Budapest, 23: 365-377.
- Jakobsen S. L., 1991 – Ein neues Gesetz schützt fossile Schätze in Dänemark. *Fossilien*, 4: 215-220.
- Knox R. W. O'B. & Harland R., 1979 – Stratigraphical relationships of the early Palaeogene ash series of NW Europe. *Journal of the Geological Society*, London, 136: 463-470.
- Marck, W. v. d. 1863 – Fossile Fische, Krebse und Pflanzen aus dem Plattenkalk der jüngsten Kreide in Westphalen. *Palaeontographica*, Stuttgart, 11: 1-83.
- Martins-Neto R., 1998 – Novos aportes ao conhecimento sobre a morfologia de *Bechleja robusta* Martins-Neto & Mezzalira, 1991, crustáceo carídeo da Formação Tremembé, Oligoceno do Estado de São Paulo. *Ciências Exatas e Tecnológicas*, Rio de Janeiro, 3 (4): 62-65.
- Martins-Neto R. G. & Mezzalira S., 1991a – Revisão dos Paleomonídeos Terciários Brasileiros (Crustacea, Caridea) com Descrição de Novos Taxa. *Anais da Academia Brasileira de Ciências*, Rio de Janeiro, 61 (4): 476.
- Martins-Neto R. G. & Mezzalira S., 1991b – Descrição de novos crustáceos (Caridea) da Formação Santana, Cretáceo Inferior do Nordeste do Brasil. *Anais da Academia Brasileira de Ciências*, Rio de Janeiro, 63 (2): 155-160.
- Milne-Edwards A., 1879 – Description d'un crustacé fossile provenant des marnes d'Aix (*Caridina nitida*). *Bulletin Société Philomathiques*, Paris, sér. 7, 3: 77-78.
- Pedersen G. K. & Buchardt B., 1996 – The calcareous concretions (cementsten) in the Fur Formation (Paleogene, Denmark): isotopic evidence of early diagenetic growth. *Bulletin of the Geological Society of Denmark*, Copenhagen, 43 (1): 78-86.
- Pinna G., 1974 – I crostacei della fauna triassica di Cene in Val Seriana (Bergamo). *Memorie Società italiana Scienze naturali Museo civico Storia naturale Milano*, Milano, XXI (1): 5-34.

- Rabadà D., 1993 – Crustacèos decàpodos lacustres de las calizas litogràfiques del Cretàcico inferior de España. Las Hoyas (Cuenca) y el Montsec de Rúbies (Lleida). *Cuadernos de Geología Ibérica*, Madrid, 17: 345-370.
- Roger J. 1946 – Les invertébratés des couches à poissons du crétacé du Liban. *Mémoires Société Géologique Française*, Paris, 23: 1-92.
- Schweigert G., 2002 – Zwei neue Garnelen (Decapoda : Dendrobranchiata, Eukyphida) aus oberjurassischen Plattenkalken Süddeutschlands. *Stuttgarter Beiträge Naturkunde*, Stuttgart, Ser. B, 323: 1-11.
- Schweigert G. & Garassino A., 2004 – New genera and species of shrimps (Crustacea: Decapoda: Dendrobranchiata, Caridea) from the Upper Jurassic lithographic limestones of S Germany. *Stuttgarter Beiträge Naturkunde*, Stuttgart, Ser. B, 350: 1-33.
- Smirnov V. P., 1929 – Decapoda aus den Fisch-Schiefern am Schwarzen Fluss in der Nähe von Wladikarkas. *Arbeiten Nord-Kaukasus Verbindung wissenschaftlichen Forschungsinstitut*, Moscow, 59: 1-48.
- Thomsen E. & Danielsen M., 1995 – Transitional Paleocene-Eocene ash-bearing diatomite in eastern North Sea. *Tertiary Research*, 15: 111-120.
- Willumsen, P. S., 2004 – Palynology of the Lower Eocene deposits of northwest Jutland, Denmark. *Bulletin of the Geological Society of Denmark*, Copenhagen, 52: 141-157.

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